

The Iniskin Peninsula is on the west side of Cook Inlet, Alaska, approximately 150 miles southwest of Anchorage (index map). The Peninsula can be reached by small boat or plane from Anchorage or ovia. Planes equipped with pontoons can land on Iniskin or Chinitna Bays and small boats can make secure anchorage in either bay. The navigational aids and hazards of the waters adjacent to the peninsula are described in the United States Coast Pilot.1/ Except above timber line, foot travel on the peninsula is difficult because of the growth of tall grass and dense underbrush. trails, traveled by numerous bears, may offer firm footing but in most places are overgrown with brush and grass. A road constructed by the Iniskin Drilling Co. from the mouth of Fitz Creek to their well site is mostly clear of brush and excellent for foot travel, but is impassable to motor travel because of slides and washouts. The only buildings now standing on the peninsula were constructed by the Iniskin Drilling Co. in 1936. The Iniskin Peninsula was not inhabited in 1946. The average relief of the interior of the peninsula is 1,000 to 1,500 feet. The highest peaks, 2,000 to 3,000 feet in altitude, form a crescentic ridge that extends from Chinitna Bay to Iniskin Bay along the Cook Inlet shoreline. The geography of the Iniskin Peninsula has been described in detail by Moffit.2/ party of the U.S. Geological Survey by Mrs. Juanita Anderson of Seldovia, Mr. Carl Williams of Iliamna, Messrs. Eric and Joe Fribrock of the Smug Harbor Packing Co., and officials of the Iniskin Drilling

INTRODUCTION

Systematic geologic investigations in the Chinitna district, including the Iniskin Peninsula, were begun in 1903 by Martin,3/continued in 1904 by Stanton and Martin,4/in 1909 by Martin and Katz,5/and in 1921 by Moffit.2/ The report by Moffit includes a topographic map of the Iniskin-Chinitna Peninsula on a scale of 1:62,500 and with a contour interval of 50 feet. period of 1934-37 in connection with the drilling of the I.B.A. well. The results of this examination have not been published but were made available to the Geological Survey for confidential review. In 1944 Lewis B. Kellum and Helmith Wedow, Jr., of the U. S. Geological Survey mapped an area of approximately 20 square miles adjacent to Fitz Creek. The geology of this area is based principally on their work. Some changes and additions have been made, however, as the result of an examination of the area by the writers in 1946. In 1946 from May 23 to September 11, the writers, mapped the structure and stratigraphy of part of the Iniskin Peninsula. The field work was concentrated in the southern half of the peninsula. Approximately the last 3 weeks of the field season were spent in the northern part of the peninsula, including Fitz Creek area, in order to correlate the 1946 field work with the work of Kellum and Wedow and earlier

Stratigraphy Triassic sedimentary rocks and Triassic and Lower Jurassic (?) igneous rocks crop out on the west side of Cook Inlet near the Iniskin Peninsula, and presumably underlie the Jurassic sedimentary rocks exposed on the peninsula. The consolidated rocks exposed on the Iniskin Peninsula consist of a conformable sequence of Lower, Middle, and Upper Jurassic marine sedi-mentary rocks. The divisions proposed for the Jurassic rocks on the Iniskin Peninsula by previous investigators and in this report are shown in the following table:

Relationship of the divisions proposed for the Jurassic sedimentary rocks exposed on the Iniskin Peninsula, Alaska

		rschner and Minard (present report)	Kel	lum and Wedow 1		Moffit 2/		Martin 3/
MIDDLE UPPER JURASSIC	Naknek formation	Upper sandstone member		Not examined	UPPER JURASSIC	arkose, sandstone,	UPPER JURASSIC	
		Pomeroy member				1)		Naknek formation
		Siltstone member				gray shale with sand- stone beds Chisik con- glomerate		
		Chisik member						Chisik conglom- erate
	Chinitna siltstone					Chinitna shale		Chinitna shale
	Tuxedni formation	Tonnie siltstone member	Tuxedni formation	upper sand- stone member upper sandy- shale member Cynthia Falls sandstone member	IDDLE JURASSIC		MIDDLE JURASSIC	Tuxedni sandstone
		Bowser member						
		Cynthia Falls sandstone member						
		Lower siltstone member		lower sandy- shale member				
LOWER	Kialagvik formation	Gaikema sandstone member	agvik	Gaikema sand- stone member	MII			
		Siltstone member	Kials	sandy shale member				

1/ Kellum, L. B., and Wedow, Helmuth, Jr., Report in preparation.
2/ Moffit, F. H., The Iniskin-Chinitna Peninsula and the Smug Harbor district, laska: U. S. Geol. Survey Bull. 789, p. 10, 1927. 3/ Martin, G. C., and Katz, F. J., A geologic recommaissance of the Iliamo region, Alaska: U. S. Geol. Survey Bull. 485, facing p. 31, 1912. The general character of the Jurassic rocks exposed on the Iniskin Peninsula is shown in the columnar sections. Each of the columnar sections was compiled and generalized from one or more sections measured in the The only other sediments exposed on the Iniskin Peninsula are Quaternary fluvial and marine sand and gravel, and possibly the remnants of glacial deposits.

Triassic and Lower Jurassic (?) rocks The oldest rocks with which the present study is concerned are Upper Triassic in age and include an unnamed light-gray limestone series and a series consisting principally of black limestone, interbedded with thin layers of light-gray quartzite, called the Kamishak chert by Martin and Katz. 5, pp. 41-47/ These rocks crop out in the vicinity of the Iniskin Peninsula and presumably underlie it. The relationship of the light-gray limestone to the Kamishak formation, with which it is associated at many places, has not been definitely determined. In the course of their field work in 1944 Kellum and Wedow examined the section on the north shore of Ursus Cove, described by Martin 6/ as the most chara minor amount of chert in the formation, they have suggested that the name Kamishak formation is more appropriate.

On the south shore of Cottonwood Bay the Kamishak formation is apparently overlain conformably by a thick series of extrusive rocks the west. 5, pp. 50-59/ The Kamishak formation and the overlying extrusive rocks are intensely folded and intruded by granitic rocks that form the core of the Aleutian Range west of the Iniskin Peninsula. On the Iniskin Peninsula boulders of the granitic rocks are not found in the exposed strata beneath the conglomerate beds in the middle part of the Middle Jurassic Tuxedni formation: they are abundant in the basal member of the Upper Jurassic Naknek formation. It is logical to place after the deposition of the Kamishak formation (Upper Triassic and the overlying extrusive rocks, but before the deposition of the middle part of the Tuxedni formation (Middle Jurassic). Inasmuch as the Lower Jurassic rocks exposed on the Iniskin Peninsula and Lower Jurassic subsurface rocks penetrated by the I.B.A. well are not morphosed as the Triassic rocks, it seems likely that the intrusion took place before deposition of the Lower Jurassic sediments that were

Jurassic sedimentary rocks Kialagvik formation. - The oldest Jurassic marine strata exposed on the Iniskin Peninsula consist of about 2,500 feet of siltstone, sandstone, and conglomerate that are assigned to the Kialagvik formation. This sequence was included in the Middle Jurassic Tuxedni sandstone b ,2/ but Kellum and Wedow have assigned it to the Lower Jurassic Kialagvik formation on the basis of its fossil content. The Kialagvik formation is exposed on the flanks of the Tonnie syncline in the northern part of the Iniskin Peninsula. During the 1944 and 1946 investigations it was examined only in the Fitz Creek area. Outcrops of the formation around the north end and west flank of the Tonnie syncline were drawn from aerial photographs. The Kialagvik formation, as exposed on the Iniskin Peninsula, has been divided by Kellum and Wedow into a lower unit, designated the sandy-shale member, and an upper unit, designated the Galkema sandstone member. Inasmuch as the lower unit is composed predominantly of siltis designated the siltstone member of the Kialagvik forma-The siltstone member of the Kialagvik formation is exposed on the flanks of the Tonnie syncline north of latitude 59° 45', and on the southwest shore of Chinitna Bay. The base of the member is not exposed. The lower unit is approximately 1,600 feet thick, according to Kellum and Wedow. The siltstone member was examined by the writers on the southwest shore of Chinitna Bay and on Tonnie Creek. The siltstone member consists predominantly of dark-gray, are weathers light-brown. Fine-grained sandstone beds are present through-out. Weathered sandstone beds have a layer or platey structure because the presence of easily weathered laminae of Wedow report that numerous fossiliferous beds are present in the unit The I.B.A. well penetrated more than 7,700 feet of strata, presumably of Lower Jurassic age, that underlie the lowest exposed beds of the siltstone member of the Kialagvik formation and are similar to it. The strata penetrated by the well can be divided into an upper part, about 6,000 feet thick, composed predominantly of dark-gray, are-naceous siltstone, and a lower part, approximately 1,700 feet thick, composed predominantly of black siltstone. Representative samples of the siltstone from the upper and lower parts of the subsurface sequence

have an average organic content of 2.05 percent.7/ The thickness and relationship of the sediments underlying the sequence penetrated by the I.B.A. well is not known. The writers believe, however, that these sediments probably overlie extrusive rocks similar to those exposed west of the Iniskin Peninsula. The Gaikema sandstone member of the Kialagvik formation, so named by Kellum and Wedow in their report in preparation, because it is well exposed on Gaikema Creek, crops out in the northern part of the peninsula adjacent to the siltstone member of the formation. The Gaikema member was examined on Tonnie Creek and on the southwest shore of Chinitna Bay by the writers. It ranges in thickness from 500 feet in the southern part of its outcrop area to about 970 feet in the northern part, according to Kellum and Wedow.

cliff-forming sandstone beds from 1 to 10 feet thick. The sandstone beds are usually separated by thin laminae of siltstone. Pebble lenses the sandstone are common and several conglomerate beds are present. The thickest conglomerate bed, approximately 50 feet, contains pebbles, cobbles, and boulders of red and green felsitic rocks, dark-gray argillite, and aphanitic igneous rocks. The matrix consists of angular grains of coarse-sand size. The sandstone beds and the sandstone matrix of the conglomerate beds consist of angular grains of feldspar and rock fragments in a fine-grained matrix of chloritic material. The rocks are dark green in fresh exposures and dark brown in weathered exposures. Numerous fossiliferous beds are present in the member, according to Kellum and Wedow. Tuxedni formation. — The exposed Jurassic strata underlying th Chinitna shale on the Iniskin Peninsula were considered by Moffit

The Gaikema sandstone member consists predominantly of resistant

Martin to be of Middle Jurassic age and were assigned by them to the Tuxedni sandstone. On the basis of later work Kellum and Wedow assigned the lower part of the Tuxedni sandstone, containing Lower Jurassic fossils, to the Kialagvik formation and the upper part, composed of interbedded marine siltstone, sandstone, and conglomerate containing Middle Jurassic and possibly Upper Jurassic fossils, to the Tuxedni formation. This restriction of the term as applied to the strata on the Iniskin Peninsula by Kellum and Wedow is accepted for the The best exposure of the Tuxedni formation is on Tonnie Creek where approximately 5,400 feet of strata, representing nearly the entire formation, is exposed between the top of Tonnie Peak and the mouth of

The Tuxedni formation has been separated by the writers into four lithologic divisions: the lower siltstone member, the Cynthia Falls sandstone member, the Bowser member, and the Tonnie siltstone member. The relationship of these to-the divisions of earlier investigators is shown in the table. The lower siltstone member of the Tuxedni formation is approximately 1,200 feet thick and is exposed in four narrow belts in the

northern and central parts of the peninsula. The unit consists o dark-gray, arenaceous siltstone beds 2 to 20 feet thick interbedded with light-gray, medium-grained sandstone beds 1 to 3 feet thick. sandstone is composed of angular grains of feldspar in a matrix of silt-size grains of feldspar and chloritic material. It is dark gray on fresh surfaces but weathers light brown. The sandstone beds common y contain layers of peobles and cobbles; a massive bed of sandstone and conglomerate is present near the middle of the member. The conglomerate consists of pebbles, cobbles, and boulders of dark-gray argillite and light-green to dark-gray volcanic rocks in a very coarse-grained, dark-green matrix of angular sand-size fragments of light-green to dark-gray volcanic rocks, chloritic material, and feldspar. The lower siltstone member contains many fossiliferous beds

Large, light-gray, fossil-bearing concretions are abundant in the upper part of the unit. Kellum and Wedow have divided this unit into a lower zone, below the conglomerate bed, characterized by several species of the ammonite Zemistephanus, and an upper zone characterized by a species of the ammonite Defonticeras. The Cynthia Falls sandstone member, 600 to 900 feet thick, was

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named from a conspicuous waterfall on Hardy Creek by petroleum geologists who examined the Iniskin Peninsula in connection with the drilling of the I.B.A. well. The name was used in unpublished reports but has not been published heretofore. The Cynthia Falls sandstone forms conspicuous hogback ridges along the flanks of the Tonnie syncline and the Fitz Creek anticline and is well-exposed in nearly all of the creeks tributary to Fitz Creek from the west. The sandstone is thick-bedded to massive, medium- to coarse-grained, and is composed of crystals and angular fragments of feldspar in a matrix of silt-size grains of feldspar and chloritic material. Minor

amounts of magnetite, quartz, and biotite are present. The sandstone is dark gray green and weathers light gray. Subrounded pebbles of uniform size form many lenticular layers in the sandstone beds. The attitude of beds is difficult to determine where included pebble beds or contacts with finer grained beds are lacking. Small light-green zones scattered in the dark-green matrix give the sandstone a spotted appearance. The light-green zones are rich in a white zeolite mineral formed by local alteration. A bed of arenaceous siltstone, present near the middle of the Cynthia Falls member, thickens from 50 feet on Tonnie Creek to at least

100 feet near the head of Fitz Creek, and on Cliff Creek several siltstone beds are present near the middle of the member. indicating that the source of the sediment was from the northwest. Few fossils have been found in the Cynthia Falls sandstone member. The name Bowser member of the Tuxedni formation is proposed in this report for a sequence of about 2,600 feet of interbedded siltstone, sandstone, and conglomerate, which crops out over a large area of the peninsula and is well exposed in the valley of Bowser Creek. member includes the upper sandy-shale member and part of the upper sandstone member recognized on Tonnie Creek by Kellum and Wedow. Some of the resistant sandstone and conglomerate beds in the member so consistently form waterfalls in the western tributaries of Fitz Creek and the eastern tributaries of Bowser Creek that a correlation based on

location of waterfalls would be possible. The Bowser member consists of thick-bedded to massive sandstone and conglomerate units 100 to 300 feet thick, interbedded with siltstone units 100 to 600 feet thick. A cliff-forming sandstone unit ranging from 500 to 800 feet in thickness forms the top of the member. The siltstone is thick-bedded and fractures into small angular pieces. Locally it is arenaceous and contains thin beds of fine-grained sandstone. The siltstone is dark gray, or light gray where calcareous, and weathers light brown. The sandstone and conglomerate units are thickbedded and massive. The sandstone beds and the sandstone matrix of the conglomerate beds are coarse-grained and are similar in structure and lithology to the Cynthia Falls sandstone member of the Tuxédni. About O percent of the pebbles, cobbles, and boulders in the conglomerate are felsite or basalt, and 10 percent are granitic rock types. The cliff-forming upper sandstone unit is well-exposed in the flanks of the Tonnie syncline. Westward-dipping beds of this unit form a hogback ridge that extends southwest from Tonnie Peak to Right Arm at an altitude of about 2,000 feet and continues southwest of Right Arm at a lower altitude. At the south end of the ridge that includes Tonnie Peak these beds are exposed in a southward-facing, nearly vertical escarpment. 2,pl. 9B/ The sandstone beds are 1 to 10 feet thick and commonly have a layered structure owing to interbedded laminae of silt stone. Part of the sandstone is light gray and part is very dark gray to black. The light-gray beds alternate with the dark-gray beds in zones ranging from a few feet to a hundred feet in thickness. the light-gray sandstone is calcareous and this is probably the reason for its lighter color. Some of the sandstone beds have a spotted appearance similar to the sandstone in the underlying Cynthia Falls

Many fossiliferous beds are present in the Bowser member. All sandstone beds near the top of the member that were carefully examined were found to be abundantly fossiliferous. Calcareous sandstone shell beds 1 to 3 feet thick, which contain many species of pelecypods including abundant speciments of Inoceramus and Trigonia, are characteristic of this unit. The name Tonnie siltstone member is here proposed for the younges member of the Tuxedni formation on the Iniskin Peninsula. It underlies

conformably the Chinitna siltstone regarded by Moffit (see table), as the oldest formation of the Upper Jurassic series. Kellum and Wedow suggest that the upper part of the Tuxedni formation (the Tonnie siltstone member and part of the Bowser member) may be Upper Jurassic. The Tonnie member crops out in the trough of the Tonnie syncline and in a long, narrow belt that extends from Chinitna Bay to Iniskin Bay along the west face of the coastal ridge. The best exposures of the member are in the vicinity of Tonnie Peak. The exposures on Tonnie Peak consist of 900 feet of siltstone capped by approximately 200 feet of sandstone. The sandstone is more resistant to erosion than the underlying siltstone and forms the summit Tonnie Peak. The sandstone at the top of Tonnie Peak is probably the highest stratigraphic horizon in the Tonnie syncline. It was probably, at most, only 100 to 200 feet stratigraphically below the base of

weathers light brown. It is thick-bedded and is so fractured into small angular pieces that the attitude of the beds is difficult to determine even where they are well-exposed. The siltstone is calcareous in part The resistant, cliff-forming sandstone beds at the top of the member range from 1 to 10 feet thick and are composed of fine- to medium-No fossils were found in the sandstone beds on Tonnie Peak. East of Bowser Creek the sandstone beds at the top of the Tonnie sil member contain a fauna that appears to be similar to the fauna in the sandstone beds near the top of the Bowser member. Chinitna siltstone. — The Chinitna siltstone, called the Chinitna shale in previous reports, consists of approximately 2,000 feet of arenaceous siltstone which lies conformably between the Tuxedni and Naknek formations. The Chinitna siltstone crops out in a band approximately 1 mile wide, extending from Chinitna Bay to Iniskin Bay along the northwest side of the coastal ridge. The formation is well-exposed in the larger eastern tributaries of

Bowser Creek that drain the west side of the ridges near Front Mountain.

Here it is predominently dark-gray siltstone. Locally thin beds of calcareous siltstone from 2 to 4 inches thick are interbedded with the

siltstone, and large ellipsoidal, calcareous concretions, oriented parallel to the bedding, are common. On the west shore of Oil Bay and the east shore of Iniskin Bay the formation is predominantly arenaceous siltstone or mudstone containing many thin beds of hard, fine-grained sandstone. The siltstone is highl ared and in most outcrops the attitude of the bedding can be determined only when layers of sandstone or calcareous concretions are The concretions are commonly fossil bearing. The most abundant fossils found in the formation are several species of genus Cadoceras.

Naknek formation. — The Naknek formation, as exposed on the Iniskin Peninsula, consists of approximately 3,500 feet of sandstone, siltstone, and conglomerate. The top of the formation is not exposed. The lithology and other physical characteristics of the formation at the localities examined by the writers on Chinitna Bay, Oil Bay, Iniskin Bay and on the peninsula between Iniskin Bay and Oil Bay are believed to be typical of the formation as exposed elsewhere on the peninsula. mately 2 miles wide, which extends from Chinitna Bay to Iniskin Bay along the coast of Cook Inlet. The Naknek sandstone and conglomera beds are more resistant to erosion than the underlying Chinitna silt-stone and form a ridge 2,000 to 3,000 feet high, including Mt. Chinitna, South Chinitna Mountain, Front Mountain, and Mt. Pomeroy. The best ex-

The Naknek formation has been divided by the writers into four lithologic units: the Chisik member, siltstone member, Pomeroy member, and upper sandstone member. The Chisik member, the basal unit of the Naknek formation, is from 300 to 600 feet thick and consists of a sandstone and a conglomerate facies. On the south shore of Chinitna Bay and on 0il Bay the member consists almost entirely of sandstone. On the east shore of Iniskin Bay the member consists of conglomerate which extends as a tongue into the sandstone. The conglomerate facies can be traced eastward to within 2 miles of Iniskin Bay, where it gradually interfingers with the sand-

posures of the formation on the Iniskin Peninsula are on the east and

west shores of Oil Bay and on the east shore of Iniskin Bay near Scott

On Oil Bay the sandstone facies of the Chisik member consists of interbedded arkose and graywacke. The fine-grained, light-gray arkose is composed predominantly of quartz and feldspar, with a small amount siltstone matrix. The graywacke is generally coarse-grained, dark gray, and is composed of angular grains of feldspar in a siltstone matrix. In the lower part of the member beds of arkose about 2 feet thick alternate with beds of graywacke 6 inches thick. At several localities this part of the member forms cliffs overlying the Chinitna siltstone. The bound ary between the Chinitna siltstone and overlying Chisik member of the in color of the weathered outcrops. The Chinitna siltstone weathers rust brown, whereas the sandstone facies of the Chisik has a banded appearance resulting from the alternation of light-brown beds with darker beds. In the upper part of the Chisik member on Oil Bay the beds of graywacke predominate, are thick, and grade upward into the overlying

The conglomerate matrix in the Chisik member is composed of coarsein the conglomerate are of intrusive rocks, 30 percent are from volcanic rocks, and 30 percent are interformational sandstone or intraformational siltstone. The dark-gray grit matrix is composed of grains of quartz, feldspar, and magnetite, and granules of siltstone and other rock types similar to the pebbles, cobbles, and boulders in the conglomerate. The marp, but its upper contact with the overlying siltstone member of the

Naknek formation is gradational. Iniskin Bay, Oil Bay, and Chinitna Bay. On Iniskin Bay the unit is approximately 700 feet thick and lies conformably between the Chisik member and the Pomeroy member. It is less resistant to erosion than the members above and below and a small bay is eroded in it. The siltstone is hard, dark gray to black, and thick-bedded. The bedding is conspicuous in reefs where the rock is being eroded by water, but not in cliffs where the rock is fractured into small angular pieces by frost action. Light-gray concretions and concretionary layers are present. They are oriented parallel to the bedding, but are not conspicuous because they have the same hardness as the siltstone. Fossils are uncommon in the Naknek formation as compared to the

fossils known to have been found in the formation were in the silt-The Pomeroy member of the Naknek formation ranges from 600 to 1,300 feet in thickness. It is similar in structure and lithology the Chisik member and has a sandstone and conglomerate facies. The contacts with the underlying siltstone member and the overlying upper sandstone member are conformable and gradational. The sandstone facies of the Pomeroy is approximately 400 feet thick on 0il Bay and 1,300 feet thick on the south shore of Chinitna Bay. The sandstone beds on 0il Bay average 10 feet in thickness and are interbedded with arenaceous siltstone beds averaging I foot in hickness. The sandstone is a gray, coarse-grained arkosic grit and it is composed of angular fragments of feldspar, of siltstone, and of other materials similar to those found in the conglomerate. The conglomerate facies of the Pomeroy member is approximately 500 feet thick on the east shore of Iniskin Bay. It forms a northwest-facing cliff and hogback ridge extending from Iniskin Bay to Mt.

Pomeroy and eastward. The southwest slope of Mt. Pomeroy is a dip slope formed on the conglomerate beds. Within 1 mile east of Mt. Pomeroy the conglomerate facies thins and grades laterally into the sandstone facies. The lithology of the conglomerate is similar to that of the conglomerate facies of the Christ weekler.

conglomerate facies of the Chisik member. On the east shore of Iniskin Bay a 100-foot sandstone bed is present at the base of the Pomeroy member and grades upward into the conglomerate facies. This sandstone is a light-gray, medium-grained arkose composed of feldspar with minor amounts of biotite and

The upper sandstone member includes the youngest Jurassic strata exposed on the Iniskin Peninsula. The top of the unit is not exposed. The thickest section measured (columnar section no. 3) is approximately 1,000 feet, but the maximum thickness of the unit on the peninsula is probably more than 3,000 feet. The upper sandstone member crops out along the east shore of the Iniskin Peninsula from Chinitna Bay nearly to Iniskin Bay. The best exposures are on the east shore of Oil Bay. The sandstone is a light-gray, medium-grained arkose composed predominantly of feldspar, with minor amounts of quartz, biotite, and magnetite. The beds average 10 feet in thickness, are usually separated by siltstone laminae, and generally grade from coarse-grained sandstone at the bottom to fine-grained sandstone at the top. No fossils have been found in this unit.

Quaternary deposits The Quaternary deposits on the Iniskin Peninsula include marine and fluvial silt and gravel, residual products of weathering, and possible glacial deposits, which unconformably overlie the Jurassic sediments. Intrusive rocks on the Iniskin Peninsula The Jurassic sedimentary rocks on the Iniskin Peninsula are

intruded by several small basalt bodies. These are not shown on the Basalt dikes were seen on Tonnie Creek, on the west shore of Oil Bay, on two west tributaries of Bowser Creek, on the east fork of Portage Creek, and on the east shore of Iniskin Bay. All of the dikes except those on Oil Bay are from 2 to 6 feet thick and are composed on fine-grained, vesicular basalt. On the east shore of Oil Bay the Chinitna formation is intruded by two parallel basalt dikes from 6 to 12 inches thick. The dikes appear to have been intruded along major vertical joint planes that trend north and have been offset a few inches by later minor joint planes parallel to the bedding east shore of Oil Bay the Naknek formation has been intruded by a

one major anticline, the Fitz Creek anticline, and two minor anticlines

The type of intrusives described above is believed to be the only kind present on the Iniskin Peninsula. The Jurassic rocks on the Iniskin Peninsula have been folded into

the Gaikema Creek anticline and the anticline along Portage Creek. The structure has been complicated by faulting. The Tuxedni formation is in contact with the extrusive rocks along a high-angle thrust fault of large displacement in the valley of Portage Creek. Compression from the west and northwest appears to have been the predominant force in the structural history of the peninsula. The principal structural feature is the Fitz Creek anticline. The axial trace of this anticline on the peninsula is nearly 14 miles long. In the northern part of the Fitz Creek area the axial trace trends

N. 40°E. but near the southern end it swings westward and trends approximately N. 50°E. North of latitude 59° 42' the axis of the anticline has no significant plunge. In the valley of Fitz Creek, the lower siltstone member of the Tuxedni formation crops out along the axis of the anticline. The lower siltstone member is bordered along the flanks of the anticline by hogback ridges formed by the Cynthia Falls sandstone member of the Tuxedni. Drag folds are present in the incompetent lower siltstone member locally. The dips in the competent Cynthia Falls sandstone member southeast of Fitz Creek show that the fold is asymmetric, with the steeper flank on the northwest side. South of the Fitz Creek with the steeper flank on the northwest side. South of the Fitz Creek Valley both limbs of the anticline have moderate dips. The dips on the ast flank generally are steeper than the dips on the west flank. Owing to the southward plunge of the axis in the southern part of the peninsula, the Cynthia Falls sandstone member probably is from 1,500 to 2,000 feet below sea level near Iniskin Bay. The structure of the Fitz Creek anticline is obscured by alluvium where the axis crosses the valley of Fitz Creek. Correlation of the beds exposed in Tonnie Creek with the beds exposed in Havenstrite Ridge and on Cliff Creek indicates that a fault with a stratigraphic throw of about 1,500 feet is present under the alluvium of the Fitz Creek Valley (cross section C-C'). The Fitz Creek anticline in this area probably is further complicated by east-trending faults which

The axial trace of the Gaikema Creek anticline trends about N. 20° E. Near Chinitna Bay the axis plunges steeply south. The Gaikema Creek anticline is separated from the Fitz Creek anticline by

a syncline whose axis is covered by the alluvium of the Fitz Creek

The anticline along Portage Creek trends N. 35° E. and is approximately parallel to the strike of the thrust fault bordering the Jurassic sediments on the west. Both limbs of the fold have steep dips. Near the axis of the anticline the dips are vertical and the rocks are sheared. Probably some faulting and displacement of beds have taken place. The axial trace of the anticline, as shown on the map, was drawn along the zone of sheared vertical beds.

The axial trace of the Tonnie syncline trends N. 40° E., and extends from the southwest shore of Chinitna Bay to Right Arm and beyond. The dips on the west flank of the syncline are, in general, steeper than the dips on the east flank. The pitch of the axis of the syncline is variable. At the north end the axis pitches southward about 20°. From Tonnie Peak south nearly to Right Arm the axis is horizontal. At Right Arm the dips on the flanks of the syncline indicate that the axis pitches a few degrees south. South of Right Arm the Tonnie syncline has been offset by a fault that trends southeast and is concealed beneath Right Arm. The axis of the syncline was traced to a point 1 mile southwest of Right Arm, where it is obscured by a large landslide. The area northwest of the Tonnie syncline and Tonnie Peak and southeast of Marsh Creek was not visited, but was mapped from aerial photographs. The structure is probably more complex than is shown on the geologic map and in the cross sections.

The faults on the Iniskin Peninsula, so far as known, are of three types: thrust faults, tear faults (transverse faults with a larger horizontal than vertical displacement, probably resulting from overthrusting), and normal faults. Only one thrust fault, the fault in Portage Creek Valley, was seen in the field, although at least two others are believed to be present. The fault in Portage Creek Valley has a displacement of several thousand feet and separates the Lower and Middle Jurassic sediments from the older extrusive rocks along the west margin of the valley. The fault is exposed in two small creeks which drain southeastward into Right Arm.

The fault plane dips 70° northwest. The extrusive rocks, mostly amygdaloidal basalt, adjacent to the fault plane are little altered, but the sandstone beds adjacent to the fault plane are drag-folded, sheared, and

On the north shore of Right Arm, 800 to 2,000 feet east of the thrust fault, agglomerate and vesicular basalt are exposed apparently in depositional contact. They are interpreted by the writer to have infaulted as a unit into the sandstone beds of the Bowser member of the Tuxedni formation. On Portage Creek, 2,000 feet upstream from its mouth, strata of similar lithology and apparently with similar structural relation to the Bowser member are exposed. The Fitz Creek fault, with a maximum stratigraphic throw of 1.500

feet, is concealed beneath the alluvium of Fitz Creek Valley. The fault has its largest displacement between latitudes 59° 45' and 59° 47' where the lower siltstone member of the Kialagvik formation is in contact with the Cynthia Falls sandstone member of the Tuxedni formation. The fault dies out 2 miles south of the I.B.A. well and probably dies out between  $2\frac{1}{2}$  and 3 miles north of the well. For two reasons the trace of the fault beneath the alluvium of the Fitz Creek Valley is believed to be west of the I.B.A. well: (1) At a depth of 100 feet the log of the I.B.A. well, prepared by the Iniskin Drilling Co., shows an 80-foot section of conglomerate that can be correlated with the conglomerate beds near the middle of the lower siltstone member of the Tuxedni formation. (2) East and northeast of the T.B.A. well, the outcrops which be concealed beneath the alluvium east of the well. graphic displacement of approximately 1,000 feet, is believed to be concealed beneath the alluvium in the Park Creek Valley.

Two tear faults were observed, and there may be others, on the west side of the Iniskin Peninsula. A block between the fault on Right Arm and the parallel fault 1 mile southwest has been displaced eastward 1,500 to 2,000 feet and uplifted 300 to 400 feet, according to a measurement of the relative displacement of a horizon on the axis of the Tonnie ncline. Both of the faults die out eastward. It is not known whether they are present as far east as the axis of the Fitz Creek anticline. A tear fault is probably present in the valley of the largest creek flowing northwestward from Tonnie Peak. Another tear fault of large displacement is probably present beneath the alluvium in Marsh Creek Valley and Chinitna Bay. Comparison of the strata on the north and south sides of Chinitna Bay indicate that the rocks on the north shore, west of longitude 153° 05' W., have been displaced upward and eastward relative to the rocks on the south shore. This fault probably dies out eastward from Marsh Creek and does not extend east of longitude 153° O5' W. The upturning of beds between Fitz Creek and Marsh Creek on the south side of Chinitna Bay probably is a result of drag folding On the east shore of Iniskin Bay the Tonnie siltstone member of

siltstone. The fault was not seen in the field but is thought to be present, because part of the Tonnie member, including the resistant ferous sandstone beds at the top, is absent at this locality The writers believe that the sandstone beds have been down-faulted on the south side of the fault (cross sections G-G' and H-H'). Whether is a normal fault, or a tear fault similar to those already described, is unknown. The only major normal fault seen by the writer is on the east shore of Oil Bay (cross section F-F'). Drag folding and faulting are common in the incompetent silt-stone beds. Folds and faults of the type commonly found in the siltstone are well-exposed in the Chinitna siltstone on Iniskin Bay in several outcrops of the Bowser member of the Tuxedni formation

on Bowser Creek.

the Tuxedni formation appears to be in fault contact with the Chinita

PETROLEUM DEVELOPMENT The presence of oil seeps near Oil Bay led to the first drilling on the Iniskin Peninsula in 1898. From 1898 to 1908 four wells were drilled near Oil Bay and two near Dry Bay. Two of the wells near Oil Bay reportedly encountered oil sands and produced some oil. petroleum development to 1920 has been described by Moffit. 2, pp. 48-54/ The only other well drilled on the Iniskin Peninsula is the Iniskin Bay Association well No. 1, located on Fitz Creek 5 miles upstream from Chinitna Bay. The well was drilled with a modern rotary rig by the Iniskin Drilling Co. of California. It was begun in 1936 and completed in 1939 at a depth of 8,775 feet. High gas pressure was encountered below 2,500 feet and oil shows at several horizons below 4,000 feet. The drilling conditions are described in more detail by P. S. Smith in the annual reports of the U. S. Geological Survey on the mineral resources of Alaska for the years 1937 to 1939 Analyses of samples of the oil and gas collected in 1946 from the

Crude oil from the Iniskin Bay Association well No. 1, Alaska Analysis by J. D. Clark, U. S. Geological Survey Approximate percent Total gasoline and naptha (including light gasoline Kerosene distillate

Medium lubricating distillate Residium A. P. I. gravity .... aybolt universal viscosity at 70°F... Saybolt universal viscosity at 100°F......31.8 sec. Pour point below 0°F. Base - intermediate

Conviscous lubricating distillate

Carbon dioxide

Natural gas from the Iniskin Bay Association well No. 1, Alaska Analysis by Fred L. Mohler, National Bureau of Standards

The greater part of the Iniskin Peninsula was included in 24 federal oil and gas leases, which expired on December 31, 1945. Preference right applications for renewal leases, filed by the lesees, are pending in the Bureau of Land Management, U. S. Department of the

PETROLEUM POSSIBILITIES Source rocks The source of the oil known to be present on the Iniskin Peninsula must have been in Jurassic or older sedimentary rocks underlying the peninsula. The only older rocks known that may underlie the peninsula and that could be a source of the oil are the Triassic limestone and the Triassic Kamishak formation which crop out southwest of the peninsula. 5/
The Triassic rocks have been described in the section on stratigraphy.

Their meterorphosed condition and their relation to later geologic Their metamorphosed condition and their relation to later geologic events precludes them as a possible source of the oil. In 1944 Kellur

and Wedow examined the Kamishak formation at Ursus Cove and reached a The lithologic characteristics of the Lower Jurassic sediments seen in the samples from the I.B.A. well suggest that they might be the source of the small amount of oil that has been obtained. Inasmuch as the section beneath the I.B.A. well is not known the possibilities for obtaining oil from these rocks cannot be evaluated. Reservoir beds

In the I.B.A. well No. 1, oil shows are reported from several horizons below 4,000 feet. Tests for production indicate that the rocks are not porous enough to permit free flow of oil into the hole. As salt water was encountered a short distance above the bottom of the hole, it can be interpreted that the hole passed through an oilbearing horizon. From the information available it is not clear whether the oil shows in the well are from fractures or from interwhether the oil shows in the well are from fractures or from inter-stitial spaces in the rocks. Because of the fine-grained, closely compacted character of the rocks it does not seem likely that oil could migrate far from its source except along fracture zones. The oil reported in the wells near 0il Bay could have come from porous beds in the Cynthia Falls sandstone member of the Tuxedni formation or from fractures in the rocks. In either case it probably migrated along fracture zones from a lower source to the position at which

it was encountered. Accumulation of petroleum The Fitz Creek anticline is probably the most favorable structure The Fitz Creek anticline is probably the most favorable structure on the Iniskin Peninsula for the accumulation of petroleum in commercial quantities. Although the anticline is complicated by faulting in the vicinity of the I.B.A. well, the well is probably an adequate test of the anticline in the Fitz Creek area to the depth drilled. South of the Fitz Creek area the axis of the anticline plunges southwest. Southeast-trending faults in the area, if any cross the axis of the anticline, probably do not have a large enough displacement to affect the migration of oil in permeable beds. From the data available it is impossible to predict the presence of stratigraphic traps in the part of the peninsula south of latitude 59° 43° N.

If oil pools are found on the Fitz Creek anticline, detailed geologic mapping to locate other parts of the Peninsula favorable for drilling would be warranted. The lithology and primary structure of the known sediments on the

accumulation of a large quantity of petroleum. Other unfavorable factors are the lack of evidence of closure on the Fitz Creek anticline and the fact that the I.B.A. well has penetrated several thousand feet of strata, presumably Lower Jurassic, without encountering a significant amount of oil. Iniskin Peninsula are not such as are normally favorable for the The most favorable factors are the shows of oil from the I.B.A. well and the presence of oil seeps. The possibility of obtaining oil from zones of highly fractured rocks also may be favorable.

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